THE TWO SPECIES OF BARRACUDA (SPHYRAENIDAE) IN THE WESTERN MEDITERRANEAN.

M. RELINI and **L. ORSI RELINI,** Istituto di Zoologia, Laboratori di Biologia Marina ed Ecologia Animale, Università di Genova, via Balbi 5, 16126 Genova, ITALY.

RÉSUMÉ. - Les deux espèces de Barracuda (Sphyraenidae) en Méditerranée occidentale.

L'étude de matériel provenant de la mer Ligure a montré que *Sphyraena viridensis* est présente depuis longtemps dans les eaux de la Méditerranée occidentale et que la livrée de cette espèce se différencie à première vue de celle de *Sphyraena sphyraena.* Une sous-espèce méditerranéenne peut être définie sur la base de caractères méristiques.

Key-words. - Sphyraenidae, *Sphyraena sphyraena, S. viridensis,* MED, Ligurian Sea.

It seems worth noting that Ligurian professional fishermen are certain of the existence of two species of barracudas, which can be distinguished by colour pattern, size and behaviour. These fishes are called "pesce scalmo" and "luccio di mare": the former, with dusky back and pale yellow belly, is fished on inshore sandy bottoms; the latter, bigger in size and with a dark grey back which forms stripes on its silvery flanks, is caught mainly at night-time at 30-50 m depth by small purse seine and small drifnets. For a long time in the Mediterranean scientific literature these two forms have been considered the juvenile and the adult of a same species, *Sphyraena sphyraena* (Bini, 1969; Tortonese, 1975; Bauchot and Pras, 1980).

The updated lists of Mediterranean fish include three species of the genus *Sphyraena*: *sphyraena, viridensis* and *chrysotaenia* (Ben Tuvia, 1986; Fisher *et al.*, 1987; Fredj and Maurin, 1987), of which the last is a Lessepsian migrant, found at present only in the Eastern Basin. This is an unmistakable species on account of its squat shape, from which derives the name "obtuse barracuda" (Ben Tuvia, 1986).

Up to now the second species, *S. viridensis*, is known only from the Lebanese coast (Ben Tuvia, 1986), but, in the opinion of some authors, its distribution could be continuous in the southern Mediterranean (Tortonese, 1975; Fisher *et al.*, 1987) and West Africa (De Sylva, 1990), overlapping with *S. sphyraena.* Given the confusion of the main Mediterranean reference works, it seems opportune to provide a history of the two species.

S. sphyraena (L., 1758) was described from Mediterranean specimens, but the type has not been preserved. Cuvier and Valenciennes (1829) described the Mediterranean species with great accuracy, contrasting it with exotic ones. For these authors the Mediterranean species, indicated by the name *S. vulgaris*, has the following meristic characteristics: D_1 5, D_2 1-8, A 1-8, P 13, C 17, V 1-5. Its body colour is dark above and silvery below; these two colours are separated by the lateral line. It is known by several common names, among which are "scalmo" in Nice and Genoa and "luccio" in Marseille. The authors did not mention a colour pattern with cross bars on the flanks and declared that they also examined large specimens ("trois pieds de longueur"). Certainly their Mediterranean specimens did not have cross bars, because Cuvier and Valenciennes (1829), when they examined a cross-barred fish from Praia San Jago, Cape Verde Island, named it as a new species *Sphyraena viridensis,* giving it this simple description: "qui ne diffère de celles de Méditerranée que parce que le brun du dos et l'argenté du ventre sont séparés par une ligne en zigzag, qui forme ainsi le long de la ligne latérale, et un peu audessus, une série de vingt ou de vingt et une grosses dentelures alternativement de ces deux couleurs". Cadenat (1964) reported a study of the type of *S. viridensis* carried out by M. Delais which established new identification characteristics: in *S. sphyraena* the scales covering the preoperculum are continuous, while in *S. viridensis* there are naked areas, both on the front margin, near the eye, and on the back margin of the operculum. In the same work, Cadenat (1964) gave the main biometric and meristic characteristics of three specimens from the Cape Verde Isles and the Canaries, but he did not count the pectoral rays and did not describe the colour pattern. He also gave the biometric and meristic characteristics of *S. sphyraena* in temperate and tropical waters, discriminating two subspecies by lateral line scale counts; he also depicted a 492 mm TL specimen without any cross bars. Comparing the five species from West Africa described in his work, one can draw the conclusion that *S. sphyraena* is the smallest one, with adults of less than 400 mm TL.

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A work by George *et al.* (1971) has not been given the consideration it deserves, in our opinion. On the Lebanese coast these authors observed the existence of two local species, one striped and the other unstriped, in addition to the immigrant from Suez, *S. chrysotaenia*. These two forms can be distinguished by some meristic characteristics, scale distribution, colour pattern, age of maturity, shape and number of piloric caeca, abundance, fishing season and common name given by local fishermen. Tortonese (1975), who was co-author of this study, summed up the results as follows: "In Lebanese waters a new, as yet unnamed, species of *Sphyraena*, was recorded; it is smaller than *S. sphyraena*, similar to it in terms of preoperculum scale pattern, but different in many other characteristics ..." Thus Tortonese considered *S. sphyraena* the bigger of the two forms.

Ben Tuvia (1971) identified one of the barracudas from Lebanon and Israel as *S. viridensis* Cuvier & Valenciennes 1829, but it is not easy to understand which of the two forms described by George *et al.* (1971) is intended, because he depicted both *S. sphyraena* and *S. viridensis* with stripes on the flanks and he assigned to *S. viridensis* the name "yellowmouth" (Ben Tuvia, 1986); this feature was associated with the unstriped form by George *et al.* (1971). In the FAO "Fiches d'identification pour les besoins de la pêche, Atlantic Centre Est" (Fisher *et al.*, 1981), De Sylva gives an identification key for the *Sphyraena* species of the area. The front or rear position of the ventral fin in respect to the first dorsal fin, and the shape of the dorsal rear tip of the opercular bone, are the main features which distinguish the *afra-barracuda-guachancho* group from the *sphyraena-viridensis* group. The identification of the last two is based on the extension of the scaled area on the preoperculum, as described by Cadenat (1964); the figures show *S. sphyraena* with about twenty stripes, while *S. viridensis* is illustrated with an irregular mottled pattern on the flanks. The same plate is given in the FAO Fiches for the Mediterranean and Black Sea (Fisher *et al.*, 1987). In this work the identification key considers a new characteristic, in addition to the preoperculum scale pattern, namely the length of the dorsal fin ray: the second and the third ray of the first dorsal fin is equal or longer in *S. sphyraena*, or shorter in *S. viridensis*, than the longest soft ray of the second dorsal fin.

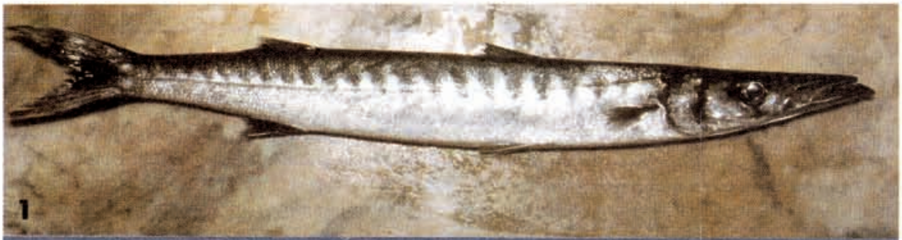
We will show further that many of the remarks made by George *et al.* (1971) can be applied to the Ligurian Sea specimens; that is to say, to the northern region of the Western Mediterranean. We have found that two barracuda species (*S. sphyraena* and *S. viridensis*) are present in this Mediterranean basin. These species are closely related, and the confusion between the two is probably explained by both being slender, with the first dorsal and the pelvic fins aligned so as to be behind the tip of the pectoral fin.

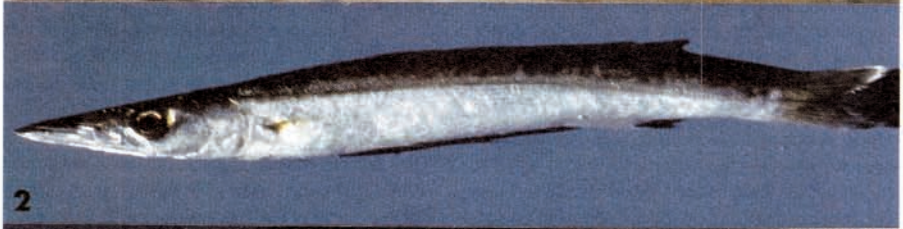
The aim of this work is not only to record the presence of *S. viridensis* in the Western Mediterranean, but above all to highlight some features which can facilitate the rapid identification of the two species, and also to suggest the possibility of a distinction between the Atlantic and a temperate, or Mediterranean, form of *S. viridensis*, similar to that proposed by Cadenat (1964) for *S. sphyraena*.

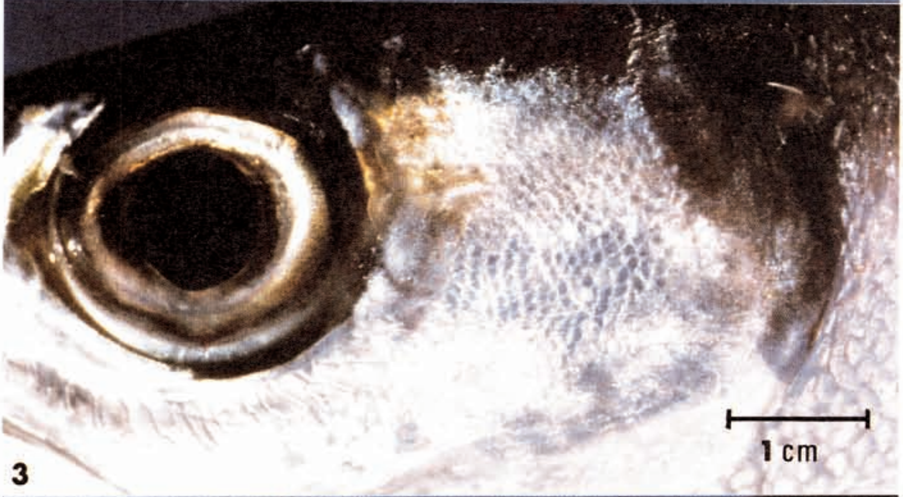
Material examined

From artisanal professional fisheries we collected five specimens of the "scalmo" fish, for us *S. sphyraena* (L.) (trammels and boat seine on sandy inshore bottoms, 5-15 m depth) (Table II) and six specimens of the "luccio di mare", for us *S. viridensis* Cuvier & Valenciennes (small drifnets and purse seine used at night and dawn, 30-50 m depth) (Table I). A juvenile of *S. sphyraena* 115 mm TL, with a blotched colour pattern, was obtained while fishing for juvenile *Sardina pilchardus* "bianchetti" (shallow water seine).

We also examined the following material from the collection of the Genoa Natural History Museum: CE.14022, Genoa Sestri Ponente, 2 Sep. 1912, one spm 515 mm TL, labelled *S. sphyraena*, but in our opinion *S. viridensis* (included in table I); CE.38835, Turkey, 22 Feb. 1962, one spm 850 mm TL, collected by Umberto Cavassa, labelled *S. sphyraena*, but in our opinion *S. viridensis*; CE.43276, St. George's Bay, Beirut (Lebanon), 9 Jun. 1965, 2 spms 305 and 385 mm TL (unstriped); labelled *Sphyraena* sp. nov., but in our opinion *S. sphyraena*; CE.41164, St. George's Bay, Beirut (Lebanon), 15 Sep. 1965, one spm 303 mm TL (striped), labelled *S. sphyraena*, but in our opinion *S. viridensis*; CE.40397, *S. sphyraena*, Genoa, Aug. 1903, 9 spms (48-110 mm TL); CE.6714, *S. sphyraena*, Genoa, Aug. 1917, 4 spms (85-122 mm TL); CE.37113, *S. sphyraena*, Genoa Cornigliano, 2 spms 360 and 295 mm TL and 3 juveniles; CE.41116, *S. sphyraena*, Genoa, 1966, about 40 spms (130-250 mm TL); CE.41089, *S. sphyraena*, Monterosso (Ligurian Sea), 1922, one spm 150 mm TL.







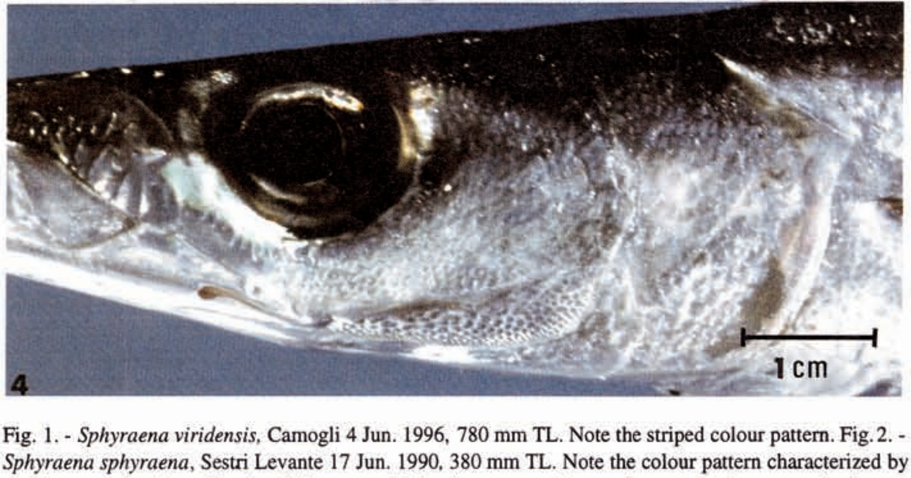


Fig. 1. - *Sphyraena viridensis,* Camogli 4 Jun. 1996, 780 mm TL. Note the striped colour pattern. Fig. 2. - *Sphyraena sphyraena*, Sestri Levante 17 Jun. 1990, 380 mm TL. Note the colour pattern characterized by the absence of stripes. Fig. 3. - *Sphyraena viridensis*, preoperculum scale pattern: there are naked areas behind the eye and on the back margin. Fig. 4. - *Sphyraena sphyraena*, specimen of figure 2, preoperculum scale pattern: all the area is scaled.

All measurements of lenghts were made with the jaws closed, starting from the tip of the lower jaw.

Results

An examination of the material found in the Ligurian Sea clearly shows that, in terms of both meristic characteristics and colouring, the two species are easy to distinguish (Tables I, II; Figs 1-4).

It is interesting that the Genoa Natural History Museum specimen no. 14022 is *S. viridensis*. This fact excludes a recent immigration of this species into the Ligurian Sea.

The *S. sphyraena* juvenile is pale beige, with the dorsal portion of the head brown-coloured and 7-8 dorsal blotches of the same colour; there are also rectangular dark blotches on the flanks and on the ventral side of the caudal peduncle. The lateral blotches cover the lateral line and are broader than they are tall, and those in the cephalic position are more widely spaced than those on the back; those on the caudal portion are almost fused.

It was possible to ascertain the changes in colour pattern related to growth, thanks to the Genoa Natural History Museum collection (CE.41116, 40397, 6714). These changes, which are linked to size, could be one of the reasons for the confusion between the two species. The blotched colour pattern was observed in specimens ranging from 48 and 134mm TL. A 207 mm specimen has the colouring of an adult, but some remains of the blotches on the flanks at the level of the lateral line are still visible. This kind of colour pattern could at first sight be mistaken for a

Table I. - *Sphyraena viridensis*: main biometric and meristic characteristics of material examined. *(Genoa Natural History Museum, spm 14022). **(Genoa Natural History Museum, spm 48808).

Date	**2 Sep. 1912**	**21 Jan. 1994**	**21 Jan. 1994**	**22 Jan. 1994**	**29 Apr. 1996**	**4 Jun. 1996**	**4 Jun. 1996**
Locality	**Sestri P. ***	**Nervi**	**Nervi**	**Sanremo**	**Nervi ****	**Camogli**	**Camogli**
TL	515	602	590	740	1055	770	780
SL	447	530	520	660	950	685	700
Head L	135	155	157	190	280	200	205
PreD1 L	195	225	228	285	415	305	315
PreD2 L	317	370	368	465	675	503	509
PreP L	135	157	156	195	280	204	210
PreV L	195	230	233	295	420	305	313
PreA L	233	377	378	475	695	515	510
Max depth	58	65	61	82	120	78	78
Depth D1	55	61	59	82	118	76	76
Depth D2	50	60	56	73	100	72	72
Snout-orbit	66	77	80	95	137	104	107
Eye horizontal diam.	17	20	21	23	27	22	22
Eye vertical diam.	16	18	20	22	25	20	20
D1	5	5	5	5	5	5	5
D2	1/9	1/9	1/9	1/9	1/9	1/9	1/9
V	1/5	1/5	1/5	1/5	1/5	1/5	1/5
A	1/9	1/9	1/9	1/9	1/9	1/9	1/9
P	14	15	15	15	15	15	15
LL	151	160	153	151	155	156	154
Scales above LL		21	21	22			
Colour pattern	striped	striped	striped	striped	striped	striped	striped

striped form. As a matter of fact, the blotches on the flanks are separated from the dark of the back and they are not vertically expanded as is the case in *S. viridensis*. The preoperculum scale pattern characteristic is not clear in specimens shorter than 120 mm.. George *et al.* (1971) observed the same colour patterns for the Lebanese unstriped form, considering 140 mm TL the size of change between the two. It has not been possible to examine *S. viridensis* juveniles from the Ligurian Sea. Once more George *et al.* (1971), described the juvenile colour pattern of the striped form, showing a plate of a 140 mm specimen, which is like an adult, with 22 bars on the flanks.

Discussion

As has been previously shown, the material examined from the Ligurian Sea allows us to identify the species *S. sphyraena* and *S. viridensis*. The diagnostic features are:

Colour pattern. - *S. viridensis* has unmistakable cross bars on the flanks, while *S. sphyraena* is dark above and silvery below; these two colours are separated by the lateral line. In *S. viridensis* the anal fin is grey, sometimes with white margins, in *S. sphyraena* it is all whitish. Colour patterns were considered a good diagnostic feature for East African barracudas (Williams, 1959) and have been used extensively in recent works (De Sylva and Williams, 1986; Daget, 1992). However, the colour inside the mouth (yellow ochre in *S. sphyraena*, white-yellow in *S. viridensis*) does not seem to be a useful characteristic, even if it is reflected in the common name "yellowmouth".

Preoperculum scale pattern. - In *S. viridensis* there is a naked area on both the front and back margins (Cadenat, 1964), while in *S. sphyraena* the scale covering is continuous.

Table II. - *Sphyraena sphyraena*: main biometric and meristic characteristics of material examined.

Date	**May 1990**	**17 Jun. '90**	**May '92**	**11 Feb. '94**	**31 Aug. '95**	**31 Aug. '95**
Locality	**La Spezia**	**Sestri L.**	**Loano**	**Celle L.**	**Imperia**	**Imperia**
TL	425	380	405	115	400	412
SL	375	335	365	-	360	373
Head L	92	96	109	34	104	108
PreD1 L	164	148	148	48	162	166
PreD2 L	265	23	253	72	254	261
PreP L	107	95	103	33	108	109
PreV L	161	147	156	49	162	165
PreA L	270	237	257	73	257	268
Max depth	41	41	33	10	37	45
Depth D1	40	41	33	10	35	45
Depth D2	-	32	31	9	37	39
Snout-orbit	36	42	44	12	46	47
Eye horizontal diam.	15	14	12	5	13	14
Eye vertical diam.	12	1	9	6	13	13
D1	5	5	5	5	5	5
D2	1/9	1/9	1/9	1/9	1/9	1/9
V	1/5	1/5	1/5	1/5	1/5	1/5
A	1/9	1/9	1/9	1/9	1/9	1/9
P	13	13	13	13	13	13
LL	140	147	149	-	150	150
Scales above LL	17	17	16	-	16	15
Colour pattern	unstriped	unstriped	unstriped	blotched	unstriped	unstriped

Pectoral fin rays. - 15 in *S. viridensis*, 13 in *S. sphyraena*.

Scales above the lateral line. - There are 15-17 scale lines in *S. sphyraena* and 21-22 in *S. viridensis*.

Some other characteristics are less clear. In *S. sphyraena* from the Ligurian Sea lateral line scales (137-150) are in the range given by Cadenat for specimens of temperate waters (135-150), while for Ligurian *S. viridensis* counts are generally higher (144-160) than those of *S. viridensis* from the Cape Verde Isles and the Canaries (137-140). George *et al.* (1971) gave numbers for the Lebanon striped form (145-153) which are similar to those from the Ligurian Sea. This might justify distinguishing a Mediterranean form of *S. viridensis*, i.e., *S. viridensis mediterranea*.

The maximum size of *S. sphyraena* reported in those works which correctly distinguish the two species is 530 mm (Cadenat, 1964), 390 mm with mature specimens from 270 mm (George *et al.*, 1971); for *S. viridensis* 820 mm, with mature specimens from 400 mm (George *et al.*, 1971). It must be remembered that in the Eastern Mediterranean several fish show smaller average sizes (Tortonese, 1951). In our present collection *S. viridensis* reach 1055 mm TL and 4400 g (this specimen is now labelled as MSNG no.48808).

Also the diagnostic feature of the relative height of the two dorsal fins is not completely true: some *S. sphyraena* have the rays of the second dorsal fin of the same size or longer than those of the first dorsal fin, but there is never a difference equivalent to that found in *S. viridensis*.

In conclusion:

1) *S. viridensis* must be added to the Italian fish fauna.

2) *S. viridensis* distribution includes the western Mediterranean, where it overlaps with that of *S. sphyraena*.

3) After Cuvier and Valenciennes (1829) only Cadenat (1964) has given precise information about the morphology and distribution of these two species, but in reference to an area outside the Mediterranean. His remarks about the sizes have been ignored and both FNAM and FAO Fiches assign the larger size to *S. sphyraena*.

S. viridensis, in the opinion of fishermen, is becoming more frequent in our area. In recent times it is gaining increasing popularity as subject for underwater photography, especially at lower latitudes (Sardinia, Balearic Islands). These images give often evidence of its schooling behaviour.

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